

REMARKS

The Office Action of February 24, 2004 has been received and carefully reviewed. Applicants request reconsideration and allowance of pending claims 1-24 and 27 in light of the following remarks.

I. REJECTIONS UNDER 35 U.S.C. § 102.

Claims 1-5, 7, 10, 11, 13-15, 19, 20, and 27 were rejected under 35 U.S.C. § 102 as being anticipated by U.S. Patent No. 6,159,821 to Cheng et al. Reconsideration and withdrawal of these rejections is respectfully requested for at least the following reasons.

A. Claims 1, 4, and 5

Independent claim 1 recites a method of stripping a hard mask from a substrate comprising *coating the substrate with a sacrificial material* that fills the gaps. The Office Action asserts on page 2, paragraph 1 that Cheng et al. disclose coating a substrate with a *sacrificial material*, referring to Cheng et al. FIGS. 3-4, item 17. *Item 17 of Cheng et al. is not a sacrificial material*, but rather, is an oxide formed in STI trenches, that remains after the silicon nitride 14 is removed (SEE FIGS. 5, 10, and 11 of Cheng et al.). Accordingly Cheng et al. fail to teach this element of claim 1 and claims 4 and 5 depending therefrom.

Claim 1 further recites *plasma etching to strip the sacrificial material and the hard mask substantially completely in a single plasma etch process*. Cheng et al. fail to teach etching to strip a sacrificial material and a hard mask substantially completely in a single plasma etch process. The Office Action refers to col. 2, lines 54-64 and FIGS. 4 and 5 of Cheng et al. However, only a portion of the layer 17 is removed in the dry etch of Cheng et al. (FIG. 4, col. 2, lines 54-56). Thus, the *oxide material 17 is not substantially completely removed, but rather remains in the STI trenches following the dry-etching, as shown in FIGS. 5, 10, and 11 of Cheng et al.* Thus, claims 1, 4, and 5 are not anticipated by Cheng et al., and Applicants respectfully request reconsideration and withdrawal of the rejection thereof under 35 U.S.C. § 102.

B. Claims 2, 3, 10, and 13-15

Independent claim 10 is directed to a method of stripping a hard mask from a substrate, comprising ***coating the substrate with a sacrificial material***, and ***plasma etching to strip the sacrificial material and the hard mask substantially completely in a single plasma etch process***, where claims 2, 3, and 13-15 depend from independent claim 10. With respect to independent claim 10, the Office Action at page 3 once again asserts that the oxide item 17 of Cheng et al. is a sacrificial material. As discussed above with respect to claims 1, 4, and 5, however, the ***item 17 of Cheng et al. is not a sacrificial material***. Accordingly, Cheng et al. fail to teach each and every element of claim 10 and claims 2, 3, and 13-15 depending therefrom. In addition, ***Cheng et al. fail to teach plasma etching to strip the sacrificial material and the hard mask substantially completely in a single plasma etch process***. Applicants therefore respectfully request reconsideration and withdrawal of the rejection of claims 2, 3, 10, and 13-15 under 35 U.S.C. § 102.

C. Claims 7, 11, 19, and 20

Independent claim 19 provides a method of removing a hard mask from a silicon containing surface, comprising ***providing a sacrificial material*** that covers the hard mask and fills gaps in the surface patterned with the hard mask, where claims 7, 11, and 20 depend from claim 19. At page 4, the Office Action refers to item 17 in FIGS. 3-4 of Cheng et al. as a sacrificial material. However, ***item 17 is not a sacrificial material***, but instead remains in the STI trenches after the dry-etching, as shown in FIGS. 5, 10, and 11 of Cheng et al. Cheng et al. therefore fail to teach each and every element of claims 7, 11, 19, and 20, whereby Applicants respectfully request reconsideration and withdrawal of the rejections thereof under 35 U.S.C. § 102.

D. Claim 27

Independent claim 27 is directed to a method of stripping a hard mask from a substrate, that recites ***coating the substrate with a sacrificial material*** that fills the gaps, ***and plasma etching to strip the sacrificial material and the hard mask in a single plasma etch process***. As discussed above, ***item 17 of Cheng et al. is not a***

sacrificial material, but rather is an oxide formed in STI trenches that remains after the silicon nitride 14 is removed, as shown in FIGS. 5, 10, and 11. Furthermore, the **material 17 is not substantially completely removed by plasma etching in Cheng et al.** Therefore, claim 27 is not anticipated by Cheng et al., and Applicants respectfully request reconsideration and withdrawal of the rejection thereof under 35 U.S.C. § 102.

II. REJECTIONS UNDER 35 U.S.C. § 103.

Claims 6, 8, 9, 12, 16-18, and 21-24 were rejected under 35 U.S.C. § 103 as being unpatentable over various combinations of U.S. Pat. No. 6,159,821 to Cheng et al., U.S. Pat. No. 5,270,265 to Hemmenway et al., and U.S. Patent No. 5,998,278 to Yu. Reconsideration and withdrawal of these rejections is respectfully requested for at least the following reasons.

A. Claims 6, 8, 9, and 12

Claims 6, 8, 9, and 12 were rejected as being unpatentable over Cheng et al. as applied to claim 19 in view of Hemmenway et al., and further in view of Yu. These claims depend from independent claim 19, and accordingly involve methods for removing a hard mask from a silicon containing surface, comprising **providing a sacrificial material** that covers the hard mask and fills gaps in the surface patterned with the hard mask, **and plasma etching to remove substantially completely the hard mask and that portion of the sacrificial material that covers the hard mask in a single plasma etch process.** As discussed above, Cheng et al. do not teach a sacrificial material as set forth in claim 19.

With respect to Hemmenway et al., the Office Action proposes at page 5, that Hemmenway et al. disclose plasma etching to remove substantially completely the hard mask and that portion of the sacrificial material that covers the hard mask, referring to Hemmenway et al. col. 3, line 46 to col. 4, line 26 and FIGS. 4-8. With respect to plasma etching, **Hemmenway et al. do not teach or suggest plasma etching to remove the mask 11, nor do Hemmenway et al. use plasma etching to remove all or a portion of the resist material 51, 63, 65.** Rather, the resist material 51 is first

irradiated (FIG. 5, col. 3, lines 46-52), the exposed resist 51 is then developed (FIG. 6, col. 3, lines 53-60) to remove the irradiated portion 63 thereof, a *wet etch* is then non-selectively applied to remove the oxide 11 (FIG. 7, col. 3, lines 61-68), and the remaining unexposed resist 65 is then removed by a *photoresist wash* (FIG. 8, col. 3, line 68 through col. 4, line 4). Thus, Hemmenway et al. do not teach all the elements of claims 6, 8, 9, and 12.

The Office Action asserts at page 6 that it would have been obvious to combine Hemmenway et al. with Cheng et al. "to enable the *sacrificial material* of Cheng et al. to be formed and furthermore to protect the bottom of the trench pattern during etching of the hard mask oxide", referring to col. 2, lines 8-19. While this cited portion of Hemmenway et al. indicates that structural defects in trench-isolated island structures are undesirable, the cited portion also specifies "protecting the bottom of the trench pattern *during etching* of the hard mask oxide, and *thereafter* removing the protection material *by a wash* that does not attack the underlying oxide" (col. 2, lines 14-19, emphasis added). Hence, **Hemmenway et al. appear to specifically teach away from a plasma etch process that could attack the underlying oxide.**

Moreover, as discussed above, **the material 17 of Cheng et al. is not a sacrificial material**, and hence, the proposed combination of Cheng et al. with Hemmenway et al. does not result in the invention as claimed.

Furthermore, **Cheng et al. appear to teach away from any proposed combination or modification thereof in which a sacrificial material is substituted for the STI isolation oxide 17** taught in Cheng et al., since a person of ordinary skill in the art would believe that such a substitution would defeat a primary purpose of the trench-fill material 17 of Cheng et al. (e.g., providing oxide 17 in the trench for isolation purposes).

Thus, **the proposed combination of Cheng et al. with Hemmenway et al. does not appear to teach the claimed invention, and there appears to be no motivation for combining these references** at all with respect to the invention as claimed.

Moreover, while the Office Action on page 5 appears to indicate that each of the claims 6, 8, 9, and 12 were rejected as unpatentable over Cheng et al. as applied to claim 19 in view of Hemmenway et al., and further in view of Yu, the Yu reference does not appear to be asserted until page 6 of the Office Action with respect to claim 12. With respect to claims 6, 8, and 9, Applicants note that Yu fails to supply the missing teachings and suggestion of the proposed combination of Cheng et al. with Hemmenway et al., whereby these claims are also believed to be patentably distinct from Cheng et al. in view of Hemmenway et al., and further in view of Yu.

With respect to claim 12, the Office Action asserts at page 6 that it would have been obvious to combine Cheng et al. with Yu so that a shallow trench isolation is accomplished, referring to col. 2, lines 32-34 of Yu. This portion of Yu (in the summary of the invention) merely states that the silicon oxide layer is removed by a wet etch process and a shallow trench isolation is accomplished, and does not appear to suggest substitution of a sacrificial material from either Hemmenway et al. or from Yu for the oxide 17 of Cheng et al. Furthermore, to the extent that the Yu reference is understood by Applicants, ***the oxide material 27, 27a in FIGS. 2C-2G of Yu*** appears to be another trench-fill oxide that ***is also not a sacrificial material*** as set forth in claims 6, 8, 9, 12, or independent claim 19. Thus, claims 6, 8, 9, and 12 are patentably distinct from the proposed combination of Cheng et al. with Hemmenway et al., and Yu, whereby reconsideration and withdrawal of the rejection thereof is respectfully requested under 35 U.S.C. § 103.

B. Claims 21 and 24

Claims 21 and 24 were rejected on pages 7 and 10, respectively, of the Office Action under 35 U.S.C. § 103 as being unpatentable over Yu in view of Cheng et al.

Claim 21 recites a method of removing a hard mask, comprising ***forming a sacrificial layer*** over the semiconductor substrate, thereby covering the hard mask layer and filling the gap, and ***removing substantially completely the sacrificial layer and the hard mask layer with a single dry etch***. Claim 24 provides a method of removing a hard mask that recites ***forming a sacrificial layer*** having a relatively planar

top surface over the semiconductor substrate, and **removing substantially completely the sacrificial layer and the hard mask layer with a single plasma etch process**. Both Cheng et al. and Yu are directed to shallow trench isolation, wherein neither reference appears to teach or suggest a sacrificial layer as set forth in claims 21 or 24. In this regard, the Office Action on page 8 refers to item 27 in FIG. 2C of Yu as a sacrificial layer. However, **the oxide material 27, 27a of Yu is not a sacrificial layer**, but rather remains in the trench after the masking layer 23 is removed (FIG. 2E). Thus, Yu fails to teach or suggest a sacrificial layer or removal of a sacrificial layer and a hard mask with a single dry etch or plasma etch. Moreover, as discussed above, Cheng et al. likewise fail to teach formation of a sacrificial layer or removal thereof with a single dry etch or plasma etch. Consequently, **the proposed combination of Cheng et al. with Yu fails to teach all the elements of these claims**, whereby Applicants respectfully request reconsideration and withdrawal of the rejection of claims 21 and 24 under 35 U.S.C. § 103.

C. Claims 22 and 23

Claims 22 and 23 were rejected on page 9 of the Office Action under 35 U.S.C. § 103 as being unpatentable over Cheng et al. in view of Hemmenway et al., and further in view of Yu. These claims depend from independent claim 21, and hence involve **forming a sacrificial layer over the semiconductor substrate, and removing substantially completely the sacrificial layer and the hard mask layer with a single dry etch**. In Cheng et al., as discussed above, the **material 17 is not a sacrificial layer**, and Cheng et al. appear to teach away from substituting a sacrificial material for the oxide 17. Furthermore, the proposed combination of Cheng et al. with Hemmenway et al. does not result in a method in which a single dry etch is used to substantially completely remove a sacrificial layer, since **Hemmenway et al. employs multiple operations to remove the mask 11 and the resist 51, 63, 65, none of which appear to be dry etching**. Moreover, the trench-fill **material 27 of Yu is not a sacrificial material**, but rather is another trench fill material like the oxide 17 in Cheng et al. Applicants therefore respectfully submit that claims 22 and 23 are non-obvious

with respect to the proposed combination of Cheng et al., Hemmenway et al., and Yu, and request reconsideration and withdrawal of the rejection of these claims under 35 U.S.C. § 103.

D. Claims 16-18

Claims 16-18 were rejected on pages 6 and 7 of the Office Action as unpatentable over Cheng et al. as applied to independent claim 10, and further in view of Hemmenway et al.

These claims depend from independent claim 10, and accordingly involve **coating the substrate with a sacrificial material, and plasma etching to strip the sacrificial material and the hard mask substantially completely in a single plasma etch process**. As discussed above, **item 17 of Cheng et al. is not a sacrificial material**, and **Cheng et al. fail to teach plasma etching to strip the sacrificial material and the hard mask substantially completely in a single plasma etch process**. Moreover, **Cheng et al. appear to teach away from any proposed combination or modification thereof in which a sacrificial material is substituted for the STI isolation oxide 17** taught in Cheng et al., since such a substitution would defeat a primary purpose of the trench-fill material 17 of Cheng et al.

Furthermore, **Hemmenway et al. do not teach or suggest plasma etching to remove the mask 11, nor do Hemmenway et al. use plasma etching to remove all or a portion of the resist material 51, 63, 65**. Rather, the resist material 51 is irradiated (FIG. 5), the exposed resist 51 is then developed (FIG. 6) to remove the irradiated portion 63 thereof, a **wet etch** is then used to remove the oxide 11 (FIG. 7), and the remaining unexposed resist 65 is then removed by a **photoresist wash** (FIG. 8). Thus, Hemmenway et al. do not teach or suggest a single plasma etch process. In addition, as discussed above, **Hemmenway et al. appear to teach away from a plasma etch process** that could attack the underlying oxide (col. 2, lines 14-19). Thus, the proposed combination of Cheng et al. with Hemmenway et al. does not render claims 16-18 unpatentable, and Applicants request reconsideration and withdrawal of the rejection of these claims under 35 U.S.C. § 103.

III. CONCLUSION

For at least the above reasons, the pending claims 1-24 and 27 are believed to be in condition for allowance and reconsideration thereof is requested.

Should the Examiner feel that a telephone interview would be helpful to facilitate favorable prosecution of the above-identified application, the Examiner is invited to contact the undersigned at the telephone number provided below.

Should any fees be due as a result of the filing of this response, the Commissioner is hereby authorized to charge the Deposit Account Number 50-1733, FASP714US.

Respectfully submitted,
ESCHWEILER & ASSOCIATES, LLC

By



Thomas G. Eschweiler
Reg. No. 36,981

National City Bank Building
629 Euclid Avenue, Suite 1210
Cleveland, Ohio 44114
(216) 502-0600

CERTIFICATE OF MAILING (37 CFR 1.8a)

I hereby certify that this paper (along with any paper referred to as being attached or enclosed) is being deposited with the United States Postal Service on the date shown below with sufficient postage as first class mail in an envelope addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: March 3, 2004



Christine Gillroy